Prince George Forest District

Vegetation Resources Inventory Strategic Inventory Plan

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EXECUTIVE SUMMARY

This VRI Strategic Inventory Plan (VSIP) outlines VRI activities and products required to address forest management and inventory issues in the Prince George Forest District as identified at the November 23, 1999 stakeholders meeting. The stakeholders include the Ministry of Forests, Ministry of Environment Lands and Parks, The Pas Lumber Company Ltd., Dunkley Lumber Ltd., and Canadian Forest Products Ltd.

The stakeholders defined the following VRI activities and products (as developed by the Resources Inventory Committee (RIC)):

1. Upgrade existing District Phase I estimates to RIC standards, and improve delineation and estimation of tree attributes (especially in spruce and spruce-leading forest types), using photo-interpretation retrofit. This will provide spatial (polygon) data to support timber, hemlock looper, ecosystem, habitat, riparian, and other mapping applications that provide information for land management.
2. Conduct timber emphasis ground sampling of the District Crown forest land to adjust Phase I estimates to provide statistically valid timber volumes and individual polygon volumes and other tree attributes to support the timber supply review process. Tree taper factors for lodgepole pine will be checked following the VRI Net Volume Adjustment Factor (NVAF) sampling methodology.
3. Conduct provincial VRI ground sampling to collect timber, ecological, range, and coarse woody debris information over the entire District. This will provide spatial and non-spatial baseline data for use in national reporting of Criteria and Indicators of sustainable forest management, provincial inventory reporting, monitoring, and research.

The VRI activities may be implemented in smaller units (e.g., Supply Blocks) across the District. They also may be jointly implemented to address common District issues within the Prince George TSA.

Estimated ground sampling sample sizes

VRI Activity	Sample size
Timber Emphasis	
Phase II Clusters	120
NVAF sampling (trees)	60
Provincial VRI (incremental)	
Phase II cluster (Full VRI)	15
Phase II TEP upgrade	45
NVAF sampling (trees)	30
WPV (polygons)	30

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1. INTRODUCTION

1.1 Background

This Vegetation Resources Inventory (VRI) Strategic Inventory Plan (VSIP) outlines VRI activities and products needed to address forest management and inventory issues in the Prince George Forest District (PGFD) as identified by stakeholders at the November 23, 1999 meeting. The VSIP outlines the strategic plan for implementing the photo interpretation, and the timber emphasis and Provincial ground sampling activities in the PGFD.

The Ministry of Forests (MOF) Resources Inventory Branch (RIB) prepared this report in consultation with the PGFD stakeholders, including the Ministry of Forests (RIB, Regional, and District staff), Ministry of Environment Lands and Parks (MELP), and area licensees. This VSIP has been reviewed and verbally-approved by the District stakeholders during the conference call on December 14, 1999. Comments from the conference call have been incorporated into this final VSIP. [1]

1.2 Vegetation Resources Inventory

The VRI is a process approved by the Resources Inventory Committee (RIC) to assess the quantity and quality of BC's timber inventory and vegetation resources. It consists of:

1. *Photo-Interpretation (Phase I)*
   - Delineating and classifying vegetation polygons using the BC Landcover Classification Scheme (BCLCS).
   - Making initial estimates of within polygon vegetation attributes.
2. *Ground Sampling (Phase II)*
   - Locating and establishing sample plots.
   - Collecting tree, site, soil, plant, and succession data as well as coarse woody debris and range data.
   - Net Volume Adjustment Factor (NVAF) sampling.
   - Within Polygon Variation (WPV) sampling.

These VRI procedures and other terms are defined in Appendix I.

[1] Some of the information in this VSIP was presented earlier in a discussion paper prepared by the RIB entitled *Prince George Forest District Vegetation Resources Inventory Forest Management and Inventory Issues Discussion Paper* (November 5, 1999).

When implemented, the VRI provide spatial and non-spatial products for resource-specific management interpretations (including timber, ecosystem, and habitat management), provincial inventory reporting, monitoring, and research. Spatial products include:

- Line work – polygon boundaries.
- Vegetation Inventory File Database – adjusted and unadjusted polygon labels and estimates.

Non-spatial products include:

- Raw Database – Raw data from field cards.
- Summary Database – Compiled data and inventory statistics.
- NVAF Database – NVAF stem analysis data (raw, compiled, and statistics).
- WPV Database – WPV polygon data (raw, compiled, and statistics).

1.3 VRI Overriding Principles

VRI procedures are being implemented throughout the province. Implementation is guided by the following principles:

- Integrating provincial inventory activities, including provincial VRI, management inventories, and the National Forest Inventory.
- Implementing inventory projects to satisfy business needs as defined in the VSIP and VRI Project Implementation Plan (VPIP) documents. The VPIP identifies priorities and spatial location of VRI activities.
- Developing spatial VRI products using a structured methodology (e.g., implement photo interpretation activities by groups such as mapsheets or watersheds, and estimate all attributes listed in the photo interpretation manual).
- Implementing inventory projects following approved VRI implementation standards as defined in the RIB 1998 report *Vegetation Resources Inventory Implementation Strategy to Integrate Management, Provincial, and National Inventories*.

VRI standards will be used when implementing inventories as addressed by the Forest Resources Commission's 1991 report *The Future of Our Forests*. These issues noted inadequate provincial forest inventories, a lack of precision statements for these inventories, inadequate non-timber information, and a narrow focus on commercial timber volume and the operable landbase.

1.4 VRI Planning

The VRI planning process develops VSIPs and VPIPs for defined areas, e.g. a Forest District. Procedures for preparing the VSIPs and VPIPs are available from Keith Tudor (MOF). The VRI

planning process is an important component of the overall VRI process and related activities (Figure 1).

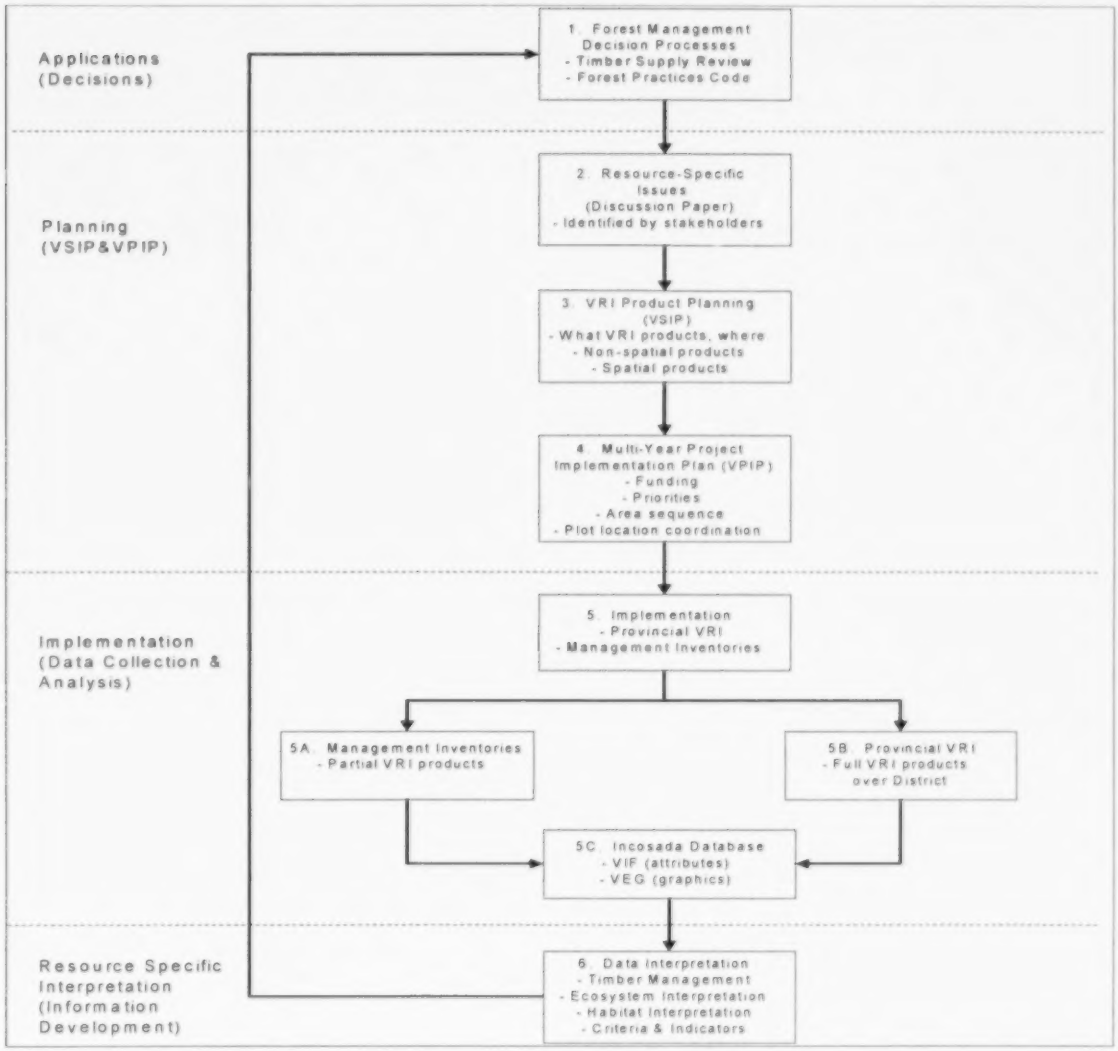

Figure 1. The Vegetation Resources Inventory process.

2. BUSINESS CONSIDERATIONS

2.1 Landbase

The PGFD is approximately 3,597,411 ha; this area includes the TSA (3,332,316 ha), TFL 30 (182,298 ha), and TFL 53 (82,797 ha). Approximately 2.3 million ha of the TSA area is Crown forest (Table 1). The remainder is non-forest, private land, reserves, and parks. The main tree species in the TSA is spruce (38%), pine (24%), balsam (18%), and deciduous (mostly aspen; 7%) (Table 2).

Table 1. PGFD TSA landbase.[2]

Land Classification	Area (ha)	%
Crown forest land	2,327,770	79.8
Immature	842,673	36.2
Mature	1,321,333	56.8
Non-Productive	58,212	2.5
Not Stocked	105,552	4.5
Non-Forest	587,884	20.2
No Typing Available	388	0.0
Total	*2,916,042*	*100*

2.2 Forest Management Considerations

Significant forest management issues in the Prince George TSA (and pertinent to the PGFD) were highlighted in the recent timber supply review data package (Table 3). Use of the VRI to address these issues is identified in Table 3, but the relative importance of the VRI on these issues is not indicated. For example, it does not show that a statistically accurate timber volume estimate may be more relevant than all other issues combined.

Other forest management issues include:

- Provincial reporting of the Criteria and Indicators (C&I) for sustainable forest management as defined by the Canadian Council of Forest Ministers.
- Provincial inventory reporting (MOF Annual Report).

Table 2. PGFD forested landbase by species

Leading Species	Area (ha)	%
Spruce	889,046	38.2
Lodgepole pine	554,262	23.8
Balsam	425,279	18.2
Aspen	168,437	7.3
Redcedar	40,312	1.7
Douglas-fir	40,091	1.7
Birch	30,037	1.3
Hemlock	24,956	1.1
Cottonwood	12,257	0.5
Other*	505	0.0
No species label	142,590	6.2
Total	*2,327,770*	*100*

*Alder, larch and white bark pine

[2] Excludes private land, reserves, and parks. Data from the forest inventory planning (FIP) file used for TSR II provided by the District.

Table 3. Forest management issues and the use of the VRI to address issues in the PGFD.

Issue[3]	VRI Implication		Remarks
	Photo-Interpretation	Ground Sampling	
1. Proposed Protected Areas: Need for Order-in-Council before proposed Protected Areas are removed permanently from the timber harvesting land base.	Not required	Not required	
2. Beetle Management impacts: insect infestations affect harvest operations and determine salvaged and unsalvaged timber volume.	Required	Required	Might provide data to estimate OAFs for beetle damage.
3. Stand-level biodiversity: assess Forest Practices Code requirements, including riparian areas and wildlife tree patches.	Required	Required	Plant lists, forage production, lichen production and shrub transects from ground sampling could be used to confirm base interpretations for wildlife. Improved photo interpretation could provide additional information on delineating wildlife habitat and protected areas.
4. Landscape-level biodiversity: assess impact of applying biodiversity emphasis options on the draft Landscape Units.	Required	Required	VRI could provide supporting data such as stand structure and age attributes; see Issue #3.
5. Cariboo and grizzly habitat: consider areas of high and medium value caribou habitat and movement corridors.	Required	Required	See Issue #3.
6. Cedar/hemlock licences: Cedar/hemlock stands are tracked seperately from other forest types in the TSR, as there is interest in maintaining the partition for these stands.	Required	Required	Spatial data from VRI could help resource identification
7. Visual Quality Objectives (VQO): create visually sensitive areas	Not required	Not required	
8. Resource Management Zones (RMZs) (geographic areas with similar values and management). 54 RMZ's have been created.	Required	Required	Any new inventory may help refine the RMZs
9. Availability of deciduous stands: assess timber supply potential from deciduous stands	Required	Required	Spatial data from the VRI could help in resource identification
10. Engelmann spruce-subalpine fir (ESSF) green-up interval	Not required	Not required	
11. Inventory audit	Required	Required	VRI ground sampling could be used to confirm the inventory audit results and to adjust the inventory.

[3] BC Ministry of Forests, Timber Supply Branch. 1998. Prince George Timber Supply Area Timber Supply Review Data Package.

2.3 Inventory History

A District inventory was done between 1990 and 1996 using former inventory standards (photo interpretation with no formal ground sampling) and a variety of certified contractors. The data was captured using a NAD27 base, transformed to NAD 83, and edited to fit TRIM I base maps. The data is current to within 2 to 3 years but may become outdated with reduced resources. The District is reviewing data on environmentally sensitive areas (ESAs) on 110 mapsheets that could be used for retrofitting Phase I.

The McGregor Model Forest (TFL 30) has nearly completed a full VRI, and TFL 53 was inventoried between 1991 and 1992 onto a TRIM I base.

2.4 Inventory Issues

The 1997 PGFD portion of the Prince George TSA mature (over 60 years old) inventory volume audit indicated that inventory volumes were over-estimated by approximately 20%. From 51 samples, the mean audit volume was 240m^3/ha and the inventory volume was 301m^3/ha. Volume bias was prevalent in spruce stands (32% over-estimation, based on 23 samples), with over-estimation of inventory heights generating most of the bias. Spruce leading stands over 60 years of age contain on average a 15% (or 5 metres) height over-estimation.[4] The bias in the overall inventory would likely be insignificant if the spruce problem was corrected. This is important since spruce-leading stands occupy 38% (approximately 0.9m ha) of the forested landbase in the District (Table 2) and are spread throughout the District with higher concentrations east of the Fraser River. VRI ground sampling, followed by statistical adjustment, could correct the volume and height biases.

Other inventory issues identified by the PGFD include:

- 50,000 ha of NSR backlog requires reclassification.
- Inaccurate inventory attributes (e.g. species composition), and approximately 30,000 ha of hemlock looper outbreak.
- A need for finer delineation in spruce timber types, brush, and alpine areas.

There are no inventory issues identified for the TFLs.

[4] Spruce as a species tends to contain higher variability in volume than other species in the PG Forest Region (Dick Nakatsu).

2.5 VRI Activities and Products

VRI activities and products required to address forest management issues outlined in Table 3 include:

1. Using photo-interpretation retrofit to upgrade existing District Phase I estimates to RIC standards, and improve delineation and estimation of tree attributes especially in spruce and spruce-leading forest types. This will provide spatial (polygon) data to support timber, hemlock looper, ecosystem, habitat, riparian, and other mapping applications that provide information for land management.
2. Conduct timber emphasis (TEP) ground sampling of Crown forestland in the District to adjust Phase I estimates. This will provide statistically valid timber and individual polygon volumes and other tree attributes to support the timber supply review. Tree taper factors for lodgepole pine will be checked following NVAF sampling methodology.
3. Conduct provincial VRI ground sampling to collect timber, ecological, range and coarse woody debris data for the entire District. This will provide spatial and non-spatial baseline data for use in national reporting of C&I of sustainable forest management, provincial inventory reporting, monitoring, and research.

3. INVENTORY PLAN

3.1 Overview

This strategic inventory plan develops specific VRI products needed to address issues and considerations discussed in Section 2. VRI products include a timber emphasis inventory in the Vegetated Treed (VT) area and Provincial ecological, timber, and range inventories over the entire District. These can be obtained through VRI photo interpretation, timber-emphasis and Provincial ground sampling, and then statistical adjustment.

3.2 Photo-Interpretation

3.2.1 Objectives

The objectives are to incorporate ecological attributes into the District's Phase I database (to RIC standards) using photo-interpretation, and to improve delineation and estimation of certain forest types (e.g. spruce stands). The product is a spatial database consisting of unadjusted photo-interpreted estimates. Ground sampling, to check and adjust the photo-interpreted estimates, is discussed as a separate process (Sections 3.3 and 3.4).

3.2.2 Target Area

The target area for populating the Phase I database with ecological attributes is the entire District landbase (including woodlots, parks, and proposed protected areas). Priority areas are caribou and grizzly habitat, rare plant associations, parks and protected areas, Carp Lake and area, Gregg Creek and area, the ICH biogeoclimatic zone, and the Parsnip watershed. There will be no re-delineation of parks or proposed park areas.

The priority strata and geographic areas for re-delineation and estimation are:

- Spruce leading stands
- Alpine areas
- Brush areas
- Cedar/hemlock leading stands
- Beetle management areas

The PGFD will decide whether to include private land in the target area for photo-interpretation.

3.2.3 Target Attributes

Target attributes are listed in the VRI photo interpretation attribute form. All attributes should be interpreted to VRI photo interpretation standards, or obtained from other sources.

3.2.4 Photo-Interpretation Approach

The photo interpretation objectives will be achieved using a retrofit. This approach will fill the gaps between old and new standards by converting the existing database to a full VRI database and collecting missing data. The retrofit methodology will:

- Populate empty fields in the database using the original document photos, other relevant photography, or ortho-photography to interpret the attributes. Data from outside sources may be used.
- Field calibration will address missing attributes, upgrade existing attribute estimations, correct attribute errors by reviewing existing attribute estimates, and identify significant errors or interpretation differences.

Issues related to the retrofit would be discussed in the photo-interpretation Project Implementation Plan (PIP). These issues include:

- Identifying how to fill gaps in the data,
- Correcting spruce heights,

- Identifying a flexible approach to change detection and remote sensing tools, such as specialized photography, and
- Identifying where new photographs are needed.

A photo interpretation VPIP should be developed following MOF guidelines in *Vegetation Resources Inventory Guidelines for Preparing a Project Implementation Plan for Photo Interpretation*. VPIP preparation involves identifying attributes to be improved (attributes or delineation), and identifying where, and how to improve them.

3.3 Timber Emphasis VRI

3.3.1 Inventory Objectives

The main objective of the timber emphasis inventory is to:

> *Install an adequate number of Phase II VRI sample clusters to adjust the timber inventory in the District VT areas (with emphasis on spruce stands), to achieve a sampling error of ±10% (95% probability) for overall net timber volume in the VT areas.*

Net timber volume is gross volume minus stumps, tops, decay, waste, and breakage. Decay and waste will be estimated using VRI call grading/net factoring and NVAF sampling. Breakage will be estimated using existing loss factors.

3.3.2 Target Population

The target population is the VT portion of the TSA, excluding private lands, parks and other officially protected areas, TFLs, and woodlots.

3.3.3 Sample Size

A minimum sample size of 120 Phase II clusters is recommended (Table 4). The proposed sample size for spruce stands is based on a target sampling error of approximately ±15% (95% probability) for net timber volume in this stratum and an estimated coefficient of variation (CV) (ratio of actual to estimated volume) of approximately 50% (from 23 inventory audit plots installed in 1997). The sample size in the remaining areas (75 clusters) is proportionate to their area relative to the spruce area (Table 4), since sample selection is with equal probability over the target population (Section 3.3.4). The sample size (120) will result in a sampling error of approximately ±9.5% (95% probability) for net

Table 4. Sample cluster distribution in the VT landbase.

Landbase	Area (%)	Number of clusters
Spruce stands	38	45
Remaining areas	62	75
Total	*100*	*120*

timber volume in the VT area, assuming an estimated CV of approximately 52% (from 51 inventory audit plots installed in 1997).

3.3.4 Sample Selection

Sample polygons will be selected by the RIB using current sample selection methods and the existing Phase I file. Sampling points will be selected with equal probability over the target population.

3.3.5 Sampling Approach

VRI Timber Emphasis Plots (TEPs) will be used to gather data following the *VRI Ground Sampling Manual*. Field observations will include measuring timber attributes and identifying site series. TEPs will provide a sampling framework for additional sampling, such as the Provincial VRI (Section 3.4), that may be required at a future date.

3.3.6 Net Volume Adjustment Factor Sampling

NVAF sampling involves detailed stem analysis of sample trees, calculation of actual net volume, and calculation of the ratio between actual net volume and estimated net volume (where estimated net volume is obtained from net factoring and taper equations). NVAF data is used to adjust the estimated net tree volume to account for hidden decay and possible taper equation bias (e.g. in pine stands). Sixty trees (50 live, 10 dead) selected from 15 VT polygons (selected with at random from the Phase II sample clusters) should be destructively sampled for NVAF.

3.3.7 Within Polygon Variation Sampling

WPV sampling provides information to estimate individual polygon error, assessed as the difference between adjusted polygon value and "true" value for that polygon based on intensive sampling of sample polygons. Typically, 10-20 polygons selected from a target population are intensively cruised using a combination of 20-50 full measure and count plots per sample polygon. The stakeholders have not decided whether to implement WPV sampling as part of the timber emphasis VRI. However, the WPV sampling could be implemented as part of the Provincial VRI sampling (Section 3.4).

3.3.8 Implementation

The timber inventory should be coordinated with photo-interpretation work and be implemented as follows:

- Step 1 – a small batch of Phase II sample clusters (e.g., 40) should be installed over the target population in the first field season (or first half of field season). This information would be used to refine the estimates of sample size.
- Step 2 – install remaining sample clusters in the second field season (or the second half of a field season).

A VPIP for ground sampling should be developed using MOF guidelines in *Vegetation Resources Inventory Guidelines for Preparing a Project Implementation Plan for Ground Sampling*.

3.4 Provincial VRI Ground Sampling

3.4.1 Objectives

A full VRI provides spatial and non-spatial baseline databases for timber and non-timber resources for the District. The full VRI ground sampling activities in the District would include:

- Additional ground sampling in the Non-Vegetated and Vegetated Non-Treed areas.
- Upgrading some TEPs to full VRI status in the VT areas.
- NVAF (in addition to timber emphasis inventory) and WPV sampling.
- Enhancing MOF ground samples as part of the National Forest Inventory (NFI) in BC.[5]

Full VRI information would provide:

1. A basis for calculating unbiased overall averages and totals for timber and non-timber vegetation resources for the District landbase.
2. Provide initial conditions and locations for measuring District-level changes and trends in sustainable forest management indicators. These can provide a statement of sustainability of District forest practices.
3. Baseline VRI data to develop SIBEC and other correlations, and to check ecosystem and habitat mapping tools.
4. Baseline data to confirm non-forest BCLCS classification and District biodiversity guidelines.
5. Provide additional information for non-timber resources (e.g., plant lists) where more intensive sampling could improve estimates for specific plants (e.g., medicinal plants) and botanical products.

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[5] The provincial NFI involves establishing 314 ground plots throughout the province on the national 20-km grid to contribute information on provincial resources to the national database providing the Federal Government with a consistent framework for reporting on Canada's inventory. Three of the 314 ground plots are in the PGFD. These ground plot locations can be obtained from the Canadian Forest Service, Victoria (Mark Gillis).

3.4.2 Target Population

The target population is the entire District landbase including both vegetated and non-vegetated areas, and parks, woodlots, and private lands.

3.4.3 Sampling Unit

Full VRI sample clusters will be installed using the current version of the *VRI Ground Sampling Manual*. Measurements will include tree attributes, plant lists and percent cover, ecological site description, soil description, old-growth designation, coarse woody debris, and range resources.

3.4.4 Sample Size

A minimum sample size of 60 full VRI samples is recommended. This would result in a sampling error of approximately 15% for net timber volume in the VT landbase (based on a CV of approximately 52%). Additional plots from the timber emphasis VRI could reduce the VT-area sampling error for net volume to ±10% for the District.

3.4.5 Sample Selection

Sample polygons will be selected by the RIB using current sample selection methods and the existing Phase I file. Sampling points will be selected with equal probability across the District.

3.4.6 NVAF and WPV Sampling

NVAF and WPV sampling are required to complete the Provincial VRI. They should be conducted as outlined in sections 3.3.6 and 3.3.7. The NVAF described in section 3.3.6 is applicable to only the VT TSA area (approximately 65% of District landbase; see Table 1), excluding private lands, parks, TFLs, and woodlots. For the provincial VRI, another NVAF is needed in the remaining areas of the District landbase, including the District Non-Vegetated and Vegetated Non-Treed areas, and VT areas in private lands, parks, TFLs, and woodlots. To ensure that sample tree selection is proportional to area, approximately 30 trees (25 live, 5 dead) from 17 polygons (15 VT and 2 non-VT) should be destructively sampled in the remaining areas.

3.4.7 Implementation

Sampling could be implemented across the District in one step to achieve Provincial VRI objectives. A ground sampling VPIP should be developed following guidelines outlined in the *Vegetation Resources Inventory Guidelines for Preparing a Project Implementation Plan for Ground Sampling*.

3.5 Implementation Priorities

The PGFD will work with stakeholders to identify project implementation priorities. A Provincial VRI and timber emphasis VRI may be implemented by smaller units (e.g., Landscape Units or Supply Blocks) identified at the District level by the District, Region, and licensees. There may be opportunity to implement projects jointly to address issues common to the Districts in the Prince George TSA.

3.6 Project Implementation Plans

The PGFD and Prince George Forest Region will coordinate stakeholder efforts to develop multi-year VPIPs based on this VSIP for submission to FRBC or other funding agencies. The VPIPs identify inventory activities, prioritize areas, annual costs, and roles and responsibilities for implementation. The VPIPs will link VRI to other Regional FRBC-related (or other agency) initiatives.

3.7 Approximate Costs

Ground samples meeting timber emphasis inventory objectives can also meet Provincial VRI objectives providing that multi-purpose plots are identified in advance. Estimated sample sizes and costs for the District VRI activities are listed in Table 5. More accurate and detailed costs should be included in the PIPs.

Table 5. Estimated sample sizes and costs for VRI in the PGFD.

VRI Activity	Sample size (plots)	Unit Cost($)	Total Cost ($)
PHOTO INTERPRETATION			
a) **Photo retrofit**	2,267,000 ha[6]	0.80/ha[7]	1,813,600
GROUND SAMPLING			
b) **Timber Emphasis (TEP)**			
Phase II Cluster	120	1,500	180,000
NVAF sampling (trees)	60	600	36,000
Total TEP			*216,000*
c) **Provincial VRI** [8]			
Phase II cluster (Full VRI)	15	2,000	30,000
Phase II upgrade TEP	45	1,500	67,500
NVAF sampling (trees)	30	600	18,000
WPV (polygons)	30	3,000	90,000
Total Provincial VRI			*205,500*
d) **Other Ground Sampling costs**:			
Quality assurance (10% of ground sampling cost)			42,150
Project management (20% of ground sampling cost)[9]			84,300
Statistical analysis			20,000
Total (Photo Interpretation and Ground Sampling)			*2,381,550*

3.8 Monitoring

The RIB is responsible for monitoring this VRI planning process and ensuring that the final VSIP is approved (Appendix II).

[6] Crown forested land in the Prince George Forest District.

[7] This cost could range from $0.80/ha to $1.60/ha, and excludes cost of photography.

[8] The provincial VRI sample sizes are incremental samples needed to upgrade the timber emphasis VRI to full VRI status.

[9] Actual project management costs will vary depending on how projects are managed (e.g. projects managed in-house would not require project management costs).

4. APPENDIX I – GLOSSARY OF TERMS

District-wide VRI

This is synonymous with provincial VRI; see Provincial VRI.

Ground Sampling

Ground sampling is the field measurement of timber, ecology, range, and/or coarse woody debris values at one or more locations within each sample polygon. Sample polygons are selected proportional to their area from a sorted list. To accommodate a wide variety of resources, various types and sizes of sampling units (e.g., fixed and variable plots, transects) are used to make the measurements.

Inventory Unit

An inventory unit is the target population from which the samples are chosen. For the provincial VRI, the inventory unit is the Forest District, which includes the timber harvesting landbase, parks, recreational areas, private, and federal lands. For management inventories, the inventory unit is a subset of the provincial VRI inventory unit that focuses on a geographic area or specific attribute set, depending upon sampling objectives.

Landcover Classification

The BC Land Cover Classification Scheme (BCLCS) was designed specifically to meet VRI requirements, in addition to providing general information useful for "global vegetation accounting" and "integrated resource management." The BCLCS is hierarchical and reflects the current state of the landcover (e.g., presence or absence of vegetation, type and density of vegetation) and such fixed characteristics as landscape position (i.e., wetland, upland, alpine). There are two main classes of polygons: Vegetated and Non-Vegetated.

Management VRI

Management VRI are specialized inventories that provide detailed information required for specific resource management, i.e., day-to-day forest management. One or more VRI sampling procedures may be used for management inventories. Management inventories may focus on specific resource types (e.g., timber, range, ecology), geographic areas (e.g., landscape unit, TFL), attribute sets (e.g., Douglas-fir leading stands, age class 4+). They may use one or more of the following tools (e.g., photo-interpretation, ground sampling, NVAF sampling).

National Forest Inventory (NFI)

The NFI provides information on Canada's resources across all provinces and allows the Federal Government a consistent framework for reporting on Canada's inventory. The inventory unit for the NFI is the entire country, although it is implemented province-by-province.

Net Volume Adjustment Factor (NVAF) Sampling

NVAF sampling provides factors to adjust net tree volume estimated from net factoring and taper equations. The adjustment accounts for hidden decay and possible taper equation bias. NVAF sampling involves detailed stem analysis of sample trees, calculation of actual net volume, and calculation of the ratio between actual net volume and estimated net volume (where estimated net volume is obtained from net factoring and taper equations).

Photo-Interpretation

Photo-interpretation involves subjective delineation of polygons and photo estimation of attributes for all polygons in an inventory unit. Medium scale aerial photographs (1:15,000) are most often used in photo-interpretation. However, if existing photo-based inventory is acceptable, the database can be translated into VRI format and upgraded to include the additional VRI attributes.

Post-Stratification

Post-stratification involves dividing inventory unit into mutually exclusive sub-populations (strata) *after* ground sampling has been completed. Samples that fall in each post-stratum are analyzed separately and the results are applied to the corresponding population post-strata to improve the precision of the inventory's overall averages and totals.

Pre-Stratification

Pre-stratification divides an inventory unit into mutually exclusive sub-populations (strata) *before* ground sampling to provide estimates for specific areas, or to increase the confidence in the overall estimates by considering special characteristics of each stratum.

Provincial VRI

The provincial VRI provides baseline data for provincial inventory reporting, monitoring, and research. All sampling procedures from the VRI toolbox are used for this inventory at the Forest

District level. The databases generated from each District inventory will be compiled to create the provincial VRI database. The provincial VRI has also been referred to in the past as the District VRI.

Resource-Specific Interpretations

Resource-Specific Interpretations (RSI) use the Resource Inventory Committee (RIC) standard VRI baseline data products (provincial VRI or management inventory), in combination with other data sets and analysis (outside of that required to produce VRI), to produce information to address specific-resource management issues (e.g., TSR review, important ecosystems, important habitats). These interpretations include ecosystem interpretations and habitat interpretations.

Retrofit

Retrofitting is the process of translating and upgrading an existing photo-based inventory to VRI standards. If the polygon linework and attributes are of acceptable quality, the existing FIP (Forest Inventory Planning) databases are translated to VIF (Vegetation Inventory Files) databases and the additional attributes required by the VRI are re-estimated from aerial photographs.

Sample Size

The sample size for an inventory is the minimum number of ground samples to be established in an inventory unit to meet the target precision.

Statistical Analysis

Statistical analysis is the process of adjusting the values of the photo-interpretation variables using ground sampling observations. For each sampled polygon, ground observations are compared to photo-estimated values to develop an adjustment factor. This factor is then applied to all polygons in the photo interpretation database to produce the final adjusted database.

Sub-unit

Sub-unit describes the inventory unit of a management inventory (i.e., the management inventory target population is a subset of the provincial VRI inventory unit). A sub-unit may be defined by a specific geographic area (e.g., operable landbase) or stand type (e.g., problem forest types) within the Forest District.

Target Precision

Target precision expresses the amount of variation in key attributes (e.g., timber volume) desired in the final results. Target precision, usually expressed as the coefficient of variation (CV), is used to calculate the minimum sample size for subsequent ground sampling.

Vegetation Resources Inventory (VRI)

VRI is an improved vegetation inventory process for assessing quantity and quality of BC's vegetation resources. The VRI process is designed to include a flexible set of sampling procedures for collecting vegetation resource information. The VRI is essentially a toolbox of procedures, which include:

- *Photo-interpretation*: the delineation of polygons from aerial photography and the estimation of resource attributes.
- *Ground sampling*: the establishment of plot clusters in selected polygons to measure timber, ecological, and/or range attributes.
- *NVAF Sampling*: stem analysis sampling of individual trees for net volume adjustment.
- *WPV Sampling*: intensive sampling of selected polygons to determine the error between the estimated attribute values and the "true" attribute values.
- *Statistical Adjustment*: the adjustment of the photo-interpreted estimates for all polygons in an inventory unit or management unit using the values measured during ground sampling.

The VRI can be deployed over the entire province (provincial VRI) measuring timber and non-timber resources, or over a large management unit (management VRI) measuring selected resources in specific portions of the landbase. The VRI sampling process produces spatial and non-spatial databases that can be used in multiple resource management applications including timber, ecosystem, and wildlife habitat management.

Within Polygon Variation Sampling

WPV sampling provides information for expressing the true individual polygon error, assessed as the difference between the adjusted polygon value and the "true" value for that polygon. The "true" value for the polygon is an estimate derived from a small sample of polygons that are intensively sampled on the ground.

5. APPENDIX II – APPROVAL/SIGNING

I have read and concur with the Prince George Forest District VRI Strategic Inventory Plan, dated 3 January 2000. It is understood that this is an agreement-in-principle and does not commit the signatories to completing the inventory activities outlined within the plan. Modifications to this plan or more detailed plans need to be reviewed and approved by the signatories.

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District Manager
Prince George Forest District

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Regional Manager
Prince George Forest Region

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Director
Ministry of Environment, Lands and Parks, Resources Inventory Branch

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Director
Ministry of Forests, Resources Inventory Branch

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Dunkley Lumber Ltd.

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Canadian Forest Products Ltd.

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The Pas Lumber Company Ltd.